Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Fostering Innovation and Investment in the Wireless Communications Market	)	GN Docket No. 09-157
	)	
	)	
A National Broadband Plan For Our Future	)	GN Docket No. 09-51

To: The Commission

COMMENTS OF WITRICITY CORPORATION

WiTricity Corporation ("WiTricity") submits these comments in response to the Notice of Inquiry issued by the Federal Communications Commission ("FCC" or "Commission") on August 27, 2009, in the above-captioned proceeding.[1] Pursuant to the *Innovation NOI*, WiTricity describes herein its wireless power transfer technology and product development activities.[2] WiTricity power sources and capture devices are specially designed magnetic resonators that efficiently transfer power over large distances via the magnetic near-field. These proprietary source and device designs, and the electronic systems that control them, support efficient energy transfer over distances that are many times the size of the sources and devices themselves. As discussed below, WiTricity's wireless power transmission products are expected to improve the convenience and reliability of mobile electronic devices; to significantly reduce the number of disposable batteries discarded every year; and to speed the adoption of green technologies such as full electric vehicles.[3]

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[1] Fostering Innovation and Investment in the Wireless Communications Market, A National Broadband Plan For Our Future*, Notice of Inquiry*, GN Dockets No. 09-157 and 09-51, FCC 09-66 (rel. Aug. 27, 2009) ("*Innovation NOI*").

[2] *See, e.g., Innovation NOI* at ¶ 54 ("We seek comment on innovations in the use of renewable energy and other green technology to makes wireless networks more energy efficient or address other environmental concerns.")

[3] WiTricity anticipates having generally available wirelessly powered/charging products available by the fourth quarter of 2010.

I. WITRICITY IS COMMERCIALIZING REVOLUTIONARY WIRELESS POWER TRANSFER SYSTEMS

A. Technology Origins

The discovery of WiTricity technology is a direct result of innovation in the wireless communications marketplace. It is told that a cell phone beeping in the middle of the night reminded Massachusetts Institute of Technology ("MIT") Assistant Professor of Physics Marin Soljačić that he had forgotten to charge his phone, but more importantly spurred his efforts to develop a technology that would permit cell phones to be charged wirelessly by using existing electricity. To make this dream a reality, Professor Soljačić needed to discover a way to transfer power from the existing wired infrastructure to his cell phone – without wires.

Very quickly, Professor Soljačić began considering the use of resonant phenomena, because he knew that two resonant objects of the same resonant frequency tend to exchange energy with each other very efficiently, while interacting only weakly with extraneous off-resonant objects. A well-known example of an acoustic resonator energy exchange is that of an opera singer singing a loud single tone in a room filled with hundreds of identical wine glasses, each filled to a different level so that each has a different acoustic resonant frequency. If the tone the opera singer is singing corresponds to the resonant frequency of one of the glasses, substantial energy may be transferred to that one glass, causing it to vibrate and even shatter, while the glasses around it absorb very little energy and remain unaffected.

Professor Soljačić realized that strongly coupled same-frequency electromagnetic resonators could be designed to safely and efficiently transfer electric power to each other, with little impact on other extraneous, non-resonant or off-resonant objects in their vicinity. Soon thereafter, he and his MIT team modeled, developed and demonstrated wireless power transmission over mid-range distances. In one of their earliest demonstrations, the team

transferred 60 Watts of power from a source resonator on one side of a room to a capture resonator and light-bulb across the room, over two (2) meters away. This demonstration confirmed that (a) power could be transferred efficiently between same-frequency resonators; (b) the transfer efficiency of the power transfer was approximately 50 percent at two (2) meters; and (c) the transfer efficiency was greater than 95 percent at resonator separations less than 60 centimeters.

The experiment validated the team's theoretical models of how electric power is wirelessly transferred as a function of the geometry, distance, and electrical properties of the devices used. Most importantly, this power transfer occurred while the resonators interacted very weakly with other objects, such as the MIT researchers who positioned themselves directly between the two resonators.

B. Critical Recognition

The results of the demonstration were published in the July 6, 2007, issue of *Science Magazine*[4] and reported by hundreds of different news agencies around the world.[5] The level of

[4] Andre Kurs, Aristeidis Karalis, Robert Moffatt, J.D.Joannopoulos, Peter Fisher, and Marin Soljačić, SCIENCE, WIRELESS POWER TRANSFER VIA STRONGLY COUPLED MAGNETIC RESONANCES, Vol. 317, 83, (2007) (also appeared in Science Express, an advance online publication of Science (June 7, 2007)).

[5] *See e.g.*, John D. Sutter, *A cordless future for electricity?* (Sept. 2, 2009), *available at* http://www.cnn.com/2009/TECH/09/02/wireless.electricity/index.html (last visited Sept. 30, 2009); Tudor Vieru, *Kiss Batteries Goodbye: Wireless Electricity Is Here* (July 24, 2009), *available at* http://news.softpedia.com/news/Kiss-Batteries-Goodbye-Wireless-Electricity-Is-Here-117506.shtml (last visited Sept. 30, 2009); Jennifer Chu, *TR10: Wireless Power* (March/April 2008), *available at* http://www.technologyreview.com/business/20248/ (last visited Sept. 30, 2009); Jeffrey Winters, *First Step to Wireless Electricity* (Dec. 21, 2007), *available at* http://discovermagazine.com/2008/jan/first-step-to-wireless-electricity (last visited Sept. 30, 2009); Clay Risen, *Wireless Energy* (Dec. 9, 2007), *available at* http://www.scientificamerican.com/article.cfm?id=wireless-energy-lights-bulb-from-seven-feet-away (last visited Sept. 30, 2009); William M. Bulkeley, *MIT Scientists Pave the Way For Wireless Battery Charging* (June 8, 2007), *available at* http://online.wsj.com/article/SB118123955549228045.html?mod=home_whats_news_us (last visited Sept. 30, 2009); USA TODAY, *MIT powers a lightbulb without wires* (June 8, 2009), *available at* http://www.usatoday.com/tech/news/techinnovations/2007-06-08-mit-wireless-power_N.htm (last visited Sept. 30, 2009); Chris Reidy and Carolyn Johnson, *MIT team lights it up - without wires* (June 8, 2007), *available at* http://www.boston.com/business/technology/articles/2007/06/08/mit_team_lights_it_up____without_wires/ (last visited Sept. 30, 2009); Brian Bergstein, *Power advance heralds future of gadgets that can be recharged wirelessly* (June 7, 2007), *available at* http://www.bookrags.com/news/mit-team-claims-wireless-power-demo-moc/ (last visited Sept. 30, 2009); Michael Kanellos, *MIT crafts wireless electricity* (June 7, 2007), *available at* http://news.cnet.com/8301-10784_3-9727045-7.html (last visited Sept. 30, 2009); J.R. Minkel, *Wireless Energy Lights Bulb*

attention indicated both the keen public interest in wireless power technologies and the need for a commercially available, wireless power transfer solution. Professor Soljačić received a Young Scholar Award for his work and has since received a MacArthur Fellowship, in part because his "method of wireless power transmission may someday lead to devices in homes, offices, and hospitals that use significant amounts of power without requiring batteries or wall-socket connections."[6]

C. Formation of WiTricity

Substantial progress towards developing and commercializing the fundamental WiTricity technology has taken place since the first experimental demonstration at MIT. In November of 2007, WiTricity Corporation was formed to transition the technology out of the laboratory and into commercial applications.[7] The company received venture capital funding; acquired office space in Watertown, Massachusetts; hired a seasoned management team with previous start-up successes; and developed an engineering team that includes experts in power electronics, circuit design, electromagnetic modeling and physics.[8] WiTricity is the sole and exclusive licensee of the MIT patents relating to this technology and has continued to develop its own extensive patent portfolio. The company was recently honored as one of the GoingGreen 100 Top Private

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from Seven Feet Away (June 7, 2009), *available at* http://www.nytimes.com/2007/12/09/magazine/09wirelessenergy.html?_r=1 (last visited Sept. 30, 2009); Jonathan Fildes, *Wireless energy promise powers up* (June 7, 2009), *available at* http://news.bbc.co.uk/2/hi/6725955.stm?lspan (last visited Sept. 30, 2009).

[6] *See* The John D. and Catherine T. MacArthur Foundation, *2008 MacArthur Fellows Marin Soljačić* (Sept. 2008), *available at* http://www.macfound.org/site/c.lkLXJ8MQKrH/b.4537289/k.9A70/Marin_Solja269i263.htm (last visited Sept. 30, 2009).

[7] *See* WiTricity, *About the Company*, *available at* http://www.witricity.com/pages/company.html (last visited Sept. 30, 2009).

[8] The WiTricity management team includes Professor Soljačić and many of his original research group.

Companies in the U.S. and was the winner of the "Energy Management, Smart Grid, and Energy Efficiency" category.[9]

II. THE APPLICATION OF WITRICITY'S WIRELESS POWER TRANSFER TECHNOLOGY

A. WiTricity's Technology Can Be Used For Direct Wireless Power Or Automatic Wireless Charging And Could Have Significant Environmental Benefits

WiTricity's wireless power transfer technology can be applied in a wide variety of applications and environments. The ability of the technology to transfer power safely, efficiently, and over distance can improve products by making them more convenient, reliable, and environmentally friendly. WiTricity technology can be used to provide:

- Direct Wireless Power – when all the power a device needs is provided wirelessly, and no batteries are required. This mode is for a device that is always used within range of its WiTricity power source.
- Automatic Wireless Charging – when a device with rechargeable batteries charges itself while still in use or at rest, without requiring a power cord or battery replacement. This mode is for a mobile device that may be used both in and out of range of its WiTricity power source.

WiTricity's vision is to develop a family of wireless electric power components that will enable Original Equipment Manufacturers ("OEMs") in a broad range of industries and applications to embed WiTricity technology into their products and systems to make them truly "wireless." Wireless electric power would be delivered over room-scale distances, with high efficiency, and in a way that is safe for both human and animals.

WiTricity has developed a number of proof-of-concept systems including wirelessly-powered televisions, laptops, keyboards, mice, picture frames and projectors, and wirelessly-recharged cell phones, game controllers, music players, PDAs, tools, and electric vehicle

[9] KPMG, *The GoingGreen 100 Top Private Companies of 2009*, *available at* http://alwayson.goingon.com/permalink/post/33354 (last visited Sept. 30, 2009).

batteries. It is estimated that over 40 billion disposable batteries are purchased every year, eventually winding up in landfills. By promoting the use of rechargeable batteries, WiTricity technology may help reduce toxic waste and greenhouse gas emissions.

The WiTricity technology also may be particularly useful in encouraging the deployment of electric vehicles ("EVs"). WiTricity engineers have worked on a prototype cordless self-charger system for EVs consisting of a power source module, which might be embedded in a garage mat, and a power capture module, which might be mounted under a vehicle chassis. The concept is that whenever an EV is parked over or nearby a power source, the cordless self-charging system will detect the presence of the vehicle, determine the battery charge level, and automatically initiate the wireless recharging protocol without any user intervention required. The "ease-of-use" of WiTricity's cordless self-chargers, compared to corded chargers, may speed the adoption of EVs in the marketplace, thereby advancing the United States' energy independence and reducing greenhouse gas emissions.

B. In The Future, WiTricity's Technology May Be Deployed In Multiple Environments, Networks, And Infrastructure Configurations

As WiTricity technology gains market acceptance, there are potentially limitless uses of wireless power transfer applications. For example, an infrastructure of WiTricity sources could be deployed in locations that currently advertise Wi-Fi "hotspots" such as shops, transportation terminals, libraries, and other gathering spots. In addition, plug-in charging kiosks for EVs are intended to be deployed in municipal, commercial, and institutional settings. The electrical and commercial infrastructure required for deploying these kiosks can be directly leveraged to eventually convert them to also support a cordless charging option, and even streamline cordless fast-charging stations. Such charging stations are considered an important complement to cordless at-home charging for EVs.

Other potential applications include:

- Direct wireless power and communication interconnections across rotating and moving "joints" (robots, packaging machinery, assembly machinery, machine tools, etc.), which can eliminate costly and failure-prone wiring.
- Direct wireless power and communication interconnections at points of use in harsh environments (drilling, mining, underwater, etc.), where it is impractical or impossible to run wires.
- Direct wireless power for wireless sensors and actuators, eliminating the need for expensive power wiring or battery replacement and disposal.
- Automatic wireless charging for mobile robots, automatic guided vehicles, cordless tools and instruments, which can eliminate complex docking mechanisms and labor intensive manual recharging and battery replacement.
- Direct wireless power interconnections and automatic wireless charging for implantable medical devices (ventricular assist devices, pacemakers, defibrillators, etc.).
- Automatic wireless powering and charging for high tech military systems (battery powered mobile devices, covert sensors, unmanned mobile robots and aircraft, etc.).
- Direct wireless powering and automatic wireless charging of smart cards.

The magnetic near field has several properties that make it an excellent means of transferring energy in many different environments including typical consumer, commercial, or industrial settings. Because most common building and furnishing materials, such as wood, gypsum wall board, plastics, textiles, glass, brick, and concrete are essentially "transparent" to magnetic fields, the WiTricity technology can efficiently transfer power through them. In addition, the magnetic near field has the ability to "wrap around" many metallic obstacles that might otherwise block the magnetic fields, and still transfer power. As outlined above, WiTricity's wireless power transmission products already are being considered for a host of applications, and given the highly flexible nature of the technology, it is expected they will be used in a multitude of environments and network infrastructures.

C. WiTricity Welcomes The Opportunity To Work On New Certification Procedures That May Be Developed For Wireless Power Technologies

As wireless electricity begins to make its way to the commercial marketplace, WiTricity will work with the FCC to develop any new certification tests and/or procedures that may be needed to support the great potential for this technology while balancing the need to coexist with the universe of other wireless products and services already available.[10] WiTricity welcomes the chance to provide insight and guidance into the operation of wireless power transfer systems and to suggest ways to harmonize standards across technologies and markets.

III. CONCLUSION

WiTricity is striving to bring an innovative technology to the marketplace, and hopes to develop products that will significantly improve the standard of living of U.S. consumers, benefit the environment, and perhaps also save lives. WiTricity appreciates the opportunity to respond to this *NOI* and is eager to work with the Commission to ensure that its wireless power transfer technology reaches its full potential and contributes to the next generation of innovation in wireless technologies, devices, and services.

Respectfully submitted,

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[10] *Innovation NOI* at ¶ 56. ("Are there other categories of devices, such as those used for wireless power transfer, for which relaxed [equipment authorization] procedures would be appropriate?") (footnote omitted).